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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/804,498	03/19/2004	John W. Hoard	81098602	7702

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EXAMINER	
EDWARDS, LOREN C	
ART UNIT	**PAPER NUMBER**
3748	

DATE MAILED: 01/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/804,498	HOARD ET AL.	
	Examiner	Art Unit	
	Loren C. Edwards	3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11,14-15,18-21,22-25* is/are rejected.

7)☒ Claim(s) *12,13,16,17 and 26-28* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/15/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on 12/15/04 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the examiner is considering the information disclosure statement.

Claim Objections

2. Claim 13 is objected to because of the following informalities: the claim reads "downstream of the nonthermal plasmas". Examiner suggests "plasma". Appropriate correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) The invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claim 15 is rejected under 35 U.S.C. 102(b) as being clearly anticipated by Hoard et al. (U.S. Pat. No. 6,363,714). Hoard discloses a method to operate a nonthermal plasma discharge device in converting NO to NO2 (Abstract; Col. 2, Lines 27-50), the nonthermal plasma discharge device being a component included in an exhaust aftertreatment system coupled to an internal combustion engine (Fig. 9, No. 10 and 18), the method comprising: supplying a quantity of fuel to the nonthermal plasma discharge device (Col. 2, Line 53 – Col. 3, Line 5); supplying a quantity of electrical

energy to the nonthermal plasma discharge device (Col. 2, Line 53 – Col. 3, Line 5); and basing the fuel quantity and electrical energy quantity on minimizing a total effective fuel consumption of the nonthermal plasma discharge device (Col. 2, Line 53 – Col. 3, Line 5).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 1, and 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor, III et al. (U.S. Pat. No. 6,843,054) in view of Hoard (U.S. Pat. No. 5,746,984). Taylor discloses a method for operating an internal combustion engine, comprising: a NOx sensor disposed downstream of an exhaust aftertreatment system (Fig. 3, No. 12, 84,86), such aftertreatment system comprising: an injector (Fig. 1, No. 38); a nonthermal plasma discharge device located downstream of the injector (Fig. 3, No. 76); and a NOx storage device located downstream of the nonthermal plasma

discharge device (Fig. 3, No. 84, and 86); and reducing an amount of electrical energy supplied to the nonthermal plasma discharge device when the NOx storage device is substantially full (Col. 6, Line 53 – Col. 7, Line 16). Taylor fails to specifically discuss operating the engine at a lean air-fuel ratio when a signal from a NOx sensor indicates that the exhaust stream contains less than a predetermined concentration of NOx. Hoard discloses an exhaust system with an emissions storage device and a plasma reactor that operates under lean burn conditions until an NOx sensor has broken a target emission level (Col. 5, Lines 20-52). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the air-fuel ratio control as taught by Hoard in the system of Taylor for the advantage of engine efficiency.

8. In regards to claim 4, the modified Taylor, as described above, discloses the method of claim 1, and further comprises: increasing electrical energy to the nonthermal plasma discharge device when a signal from the NOx sensor indicates that exhaust gases contain more than a predetermined concentration of NOx and the NOx storage device is not substantially full (Taylor, Col. 6, Line 53 – Col. 7, Line 16; Hoard, Col. 5, Lines 20-52).

9. In regards to claim 5, the modified Taylor, as described above, discloses the method of claim 1, and further comprises: increasing an amount of fuel supplied to the nonthermal plasma discharge device when a signal from the NOx sensor indicates that the exhaust gas contains more than the predetermined concentration of NOx and the

NOx storage device is not substantially full (Taylor; Col. 6, Line 53 – Col. 7, Line 16; Hoard Col. 5, Lines 20-52).

10. Claims 2-3, 6-8, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor as applied to claim 1 above, and further in view of Schnaibel et al. (U.S. Pat. No. 6,324,834). The modified Taylor discloses the method of claim 1, as described above, but fails to specifically discuss providing exhaust gases with a rich air-fuel ratio when the NOx storage device is full. Schnaibel discloses a method for running an internal combustion engine in conjunction with a NOx-accumulator catalytic converter that runs the engine and subsequently the exhaust gas at a rich air-fuel ratio when the NOx trap is full (Col. 1, Lines 1-30). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the air-fuel ratio control of Schnaibel in the method of Taylor for the advantage of purging the NOx trap without additional mechanical equipment.

11. In regards to claim 3, the modified Taylor discloses the method of claim 2, as described above, and further comprises the ability to determine whether the NOx storage device is substantially full (Taylor, Col. 7, Lines 3-4).

12. In regards to claim 6, the modified Taylor, as described above, discloses the method of claim 3 and further wherein the NOx storage device is determined to be substantially full based on a model of the engine predicting engine generated NOx (Taylor, Col. 6, Line 53 – Col. 7, Line 16).

13. In regards to claim 7, the modified Taylor, as described above, discloses the method of claim 3 and further wherein the NOx storage device is determined to be substantially full based on a signal fro the NOx sensor (Hoard, Col. 5,Lines 21-52).

14. In regards to claim 8, the modified Taylor, as described above, discloses the method of claim 3 and further wherein the NOx storage device is determined to be substantially full when a signal from the NOx sensor indicates a NOx concentration exceeding a predetermined concentration (Hoard, Col. 5,Lines 21-52).

15. In regards to claim 19, the modified Taylor, as described above, discloses a method for operating an internal combustion engine comprising: operating the engine at a lean air-fuel ratio when a NOx storage device coupled to the engine exhaust is not full (Hoard, Col. 5, Lines 21-52), the NOx storage device is part of an exhaust aftertreatment system, the aftertreatment system further comprising: a nonthermal plasma discharge device located upstream of the NOx storage device (Taylor, Fig. 3, No. 12, 84, and 86); and providing exhaust gases with a rich air-fuel ratio when the NOx storage device is substantially full (Schnaibel, Col. 1, Lines 1-30).

16. In regards to claim 20, the modified Taylor, as described above, discloses the method of claim 19 and further wherein determination that the NOx storage device is full is based on a signal from a NOx sensor disposed downstream of the NOx storage device (Hoard, Col. 5,Lines 21-52; Taylor, Fig. 3, No. 154).

17. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor, III as applied to claim 3 above, and further in view of Ali et al. (U.S. Pat. No. 6,775,623). The modified Taylor discloses the method of claim 3, as described above,

but fails to specifically discuss the engine generated NOx being based on a lookup table based on engine speed and torque. Ali discloses a real-time NOx estimation process that uses engine speed and torque to estimate the amount of NOx generated by the engine (Abstract). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the NOx estimation as taught by Ali in the method of Taylor for the advantage of accurate and dynamic estimations of NOx.

18. In regards to claim 10, the modified Taylor discloses the method of claim 3, as described above, and further wherein the NOx storage device is determined to be substantially full based on a lookup table based on engine speed and torque (Taylor, Col. 7, Lines 5-16; Ali, Abstract).

19. Claims 11 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor in view of Hoard et al. (U.S. Pat. No. 6,363,714). Taylor discloses a method for operating an internal combustion engine, comprising: providing an exhaust aftertreatment system coupled to the engine, such exhaust aftertreatment system having an injector (Fig. 1, No. 38), a nonthermal plasma discharge device located downstream of the injector (Fig. 1, No. 12), a NOx storage device located downstream of the nonthermal plasma discharge device (Fig. 3, No. 84 and 86), and a NOx sensor located downstream of the NOx storage device (Fig. 3, No. 154). Taylor discusses controlling the fuel and energy provided to the plasma device (Col. 6, Line 53 – Col.7, Line 16), but fails to specifically discuss determining a desired NO to NO2 conversion efficiency and providing a quantity of fuel and a quantity of electrical energy to the nonthermal plasma discharge device based on the desired conversion efficiency.

Hoard (6,363,714) discloses a plasma-catalyst control system that controls the Joules/Liter specific energy deposition in accordance with measured values of engine operating parameters in order to optimize emission reduction versus energy cost (Abstract). Hoard discloses the change in fuel efficiency with respect to NOx conversion efficiency (Fig. 5 and 6; Col. 3, Line 30 – Col. 4, Line 26). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the J/L control as taught by Hoard in the method of Taylor to reduce the electrical power consumption of the plasma device (Col. 2, Lines 47-50).

20. In regards to claim 14, the modified Taylor, as described above, discloses the method of claim 11 and further wherein the exhaust aftertreatment system comprises a NOx storage device located downstream of the nonthermal plasma discharge device (Taylor, Fig. 3, No. 84 and 86).

21. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoard et al. (U.S. Pat. No. 6,363,714) in view of Taylor (U.S. Pat. No. 6,843,054). Hoard discloses the method of claim 15 as described above but fails to specifically discuss there being a NOx trap located downstream of the plasma device. Taylor discloses a method and apparatus for removing NOx and soot from an engine exhaust that contains a plasma device and a NOx trap located downstream thereof (Fig. 3, No. 84 and 86). It would have been obvious to one having ordinary skill in the art at the time that the invention was made to utilize the NOx trap and location as taught by Taylor in the method of Hard for the advantage of better emissions control.

22. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor as applied to claim 19 above, and further in view of Hoard et al. (U.S. Pat. No. 6,363,714). The modified Taylor, as described above, discloses the method of claim 19, but fails to specifically discuss that the amount of electrical energy provided to the nonthermal discharge device is reduced in response to providing rich exhaust gases. Hoard (6,363,714) discloses a plasma-catalyst control system that reduces the amount of power supplied to a plasma device when the NOx in the exhaust is at low values (Col. 2, Line 53 – Col. 3, Line 5). It is well known that rich air-fuel ratios result in smaller amounts of NOx in the exhaust stream. It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the plasma power control as taught by Hoard in the method of Taylor for the advantage increased efficiency.

23. Claims 22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor in view of Kokusyo et al. (U.S. Pat. No. 6,792,751). Taylor discloses a method for operating an exhaust aftertreatment system coupled to an internal combustion engine, comprising: a NOx sensor in an exhaust aftertreatment system that indicates when a predetermined level of NOx has been reached (Col. 9, Lines 50-56), wherein the exhaust aftertreatment system comprises a nonthermal plasma discharge device (Fig. 3, No. 12), a NOx storage device located downstream of the nonthermal plasma discharge device (Fig. 3, No. 84 and 86), and the NOx sensor is located downstream of the NOx storage device (Fig. 3, No. 154). Taylor discusses being able to control the

fuel to the reformer (Col. 6, Line 53 – Col. 7, Line 16) but fails to specifically discuss increasing a quantity of fuel supplied when a signal from the NOx sensor indicates an excess of a predetermined NOx level. Kokusyo discloses an exhaust gas purification device and method that increases the amount of fuel when a NOx trap needs to be purged, i.e. when a NOx level has been exceeded (Col. 1, Lines 38-57). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the fuel control of Kokusyo in the method of Taylor for the advantage of purging the NOx traps.

24. In regards to claim 23, the modified Taylor, as described above, discloses the method of claim 22 and further wherein the fuel supplied is by a fuel injector located in the engine exhaust upstream of the nonthermal plasma discharge device (Taylor, Fig. 1, No. 38).

25. In regards to claim 24, the modified Taylor, as described above, discloses the method of claim 22 and further wherein the NOx storage device is located downstream of the nonthermal plasma discharge device (Taylor, Fig. 3, No. 12, 84, and 86) and the NOx sensor is located downstream of the NOx storage device (Taylor, Fig. 3, No. 84, 86, and 154).

26. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor as applied to claim 22 above, and further in view of Hoard (U.S. Pat. No. 6,363,714). Taylor discloses the method of claim 22, as described above, and discusses controlling the energy provided to the plasma reformer (Taylor, Col. 6, Line 53 – Col. 7 Line 16), but fails to specifically discuss increasing the energy to the plasma device based on a

signal from the NOx sensor. Hoard (6,363,714) discloses a plasma-catalyst control system that increases the electrical energy in high NOx conditions (Col. 2, Line 52 – Col. 3, Line 5). It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the plasma energy control as taught by Hoard in the method of Taylor for the advantage of improved energy cost versus emission performance (Col. 3, Lines 4-5).

Allowable Subject Matter

27. Claims 12-13, 16-17, and 26-28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

28. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Cho et al. (U.S. Pat. No. 6,959,538) discloses an ultra low power plasma reactor system for automotive NOx emission control. Smaling (U.S. Pat. No. 6,758,035) discloses a method and apparatus for purging SOx from a NOx trap. Tamura et al. (U.S. Pat. No. 6,532,733) discloses a plasma exhaust gas treatment device. Hemingway et al. (U.S. Pub. No. 2002/0076368 A1) discloses a non-thermal plasma reactor for lower power consumption. Balko et al. (U.S. Pat. No. 6,176,078) discloses plasma fuel processing for NOx control of lean burn engines. Penetrante et al. (U.S. Pat. No. 6,038,853) discloses a plasma-assisted catalytic storage reduction system.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Loren C. Edwards whose telephone number is (571) 272-2765. The examiner can normally be reached on M-TH 5:30-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Denion can be reached on (571)272-4859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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